

Climate Change Modeling with EDRAM

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EDRAM

- Computable General Equilibrium Model of the entire California Economy.
- Built in collaboration with Department of Finance and the Air Resources Board.
- Model Code and Data available for public use.
- Current version is 120 Industrial Sector Version in collaboration with ARB

General Equilibrium

- The model solves for the prices of goods and services and factors of production that make quantity demanded and supplied equal.
- Both physical goods and money are conserved.

Sources

- The sources are fully documented.
- US Make/Use table is the primary source for industry intermediate requirements (1997).
- Employment is from CA EDD ending Q1 2003.
- It is corrected for energy use data (CALEB 2000, LBL study)
- Demand was estimated from Consumer Expenditure Survey for the Western US.
- State Government data from state records
- Most parameters (e.g., elasticity of substitution) taken from literature.

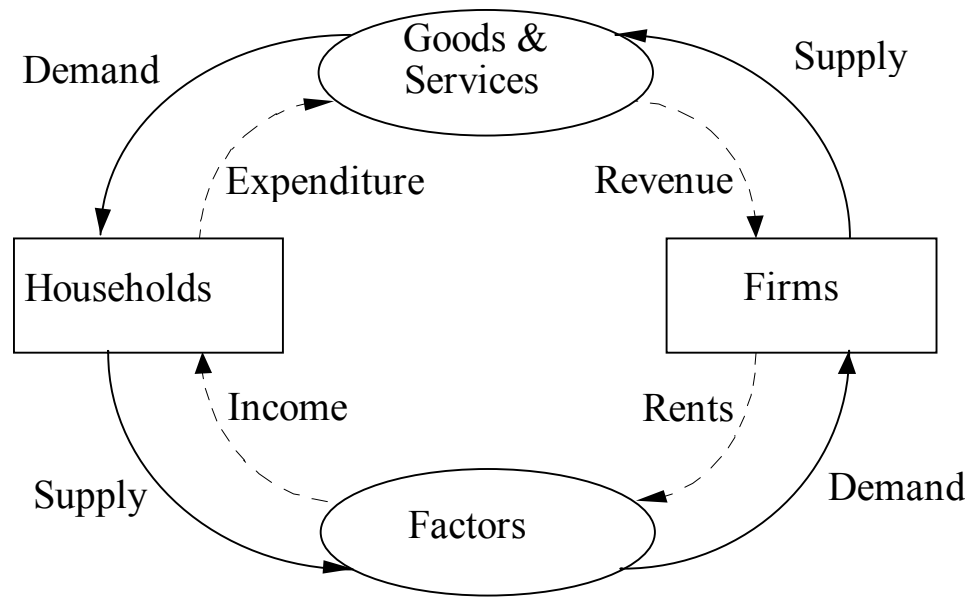
Future years

- Future years (without policy changes) are constructed by use of forecasts for
 - personal income
 - population
 - energy use
 - (these imply an estimate of technical progress)

Structure of E-DRAM

- 188 distinct sectors:
 - 120 industrial sectors,
 - two factor sectors (labor and capital),
 - 10 household sectors,
 - 9 consumption sectors,
 - one investment sector,
 - 45 government sectors, and
 - one sector that represents the rest of the world.

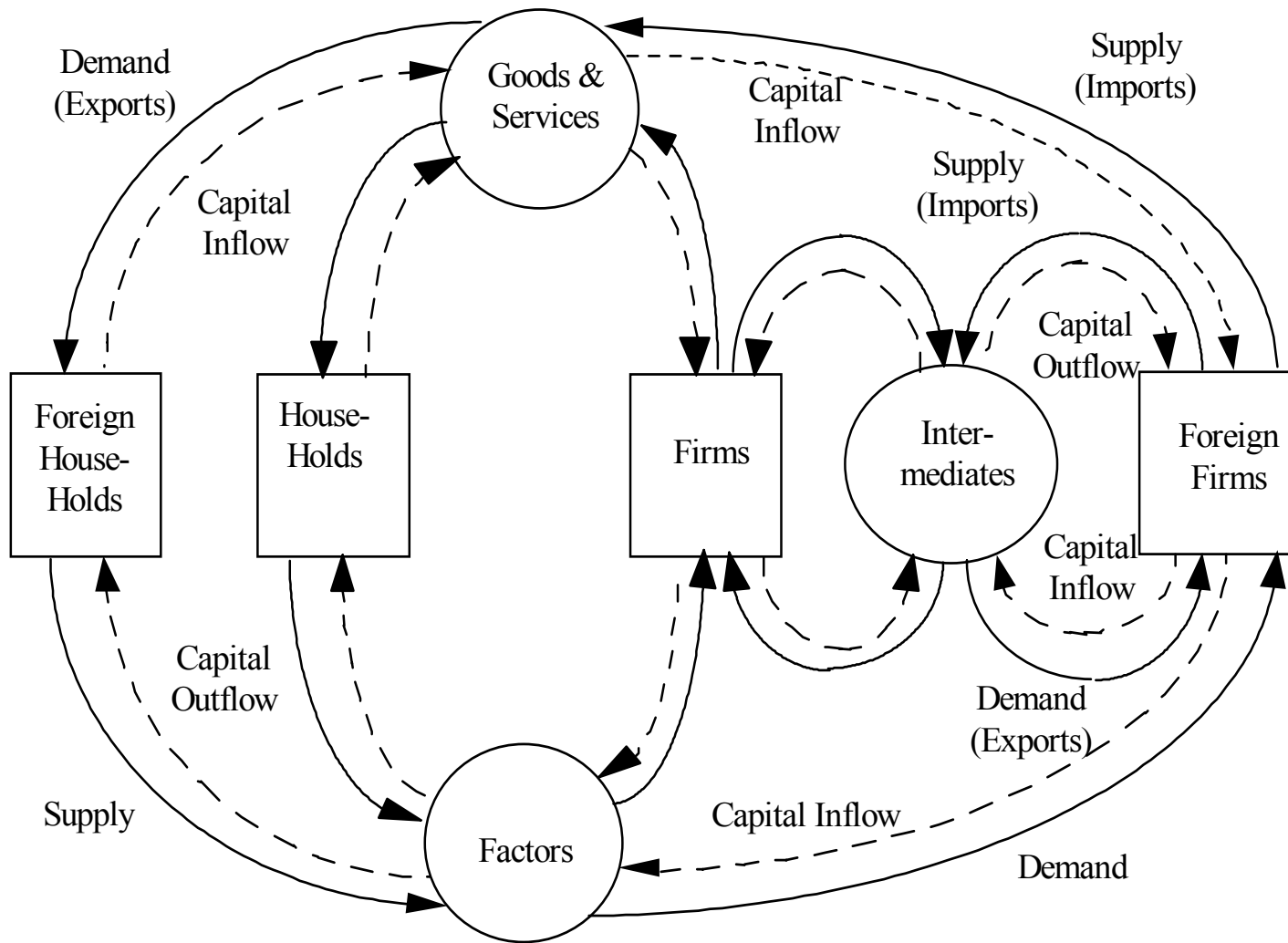
Goods and Services

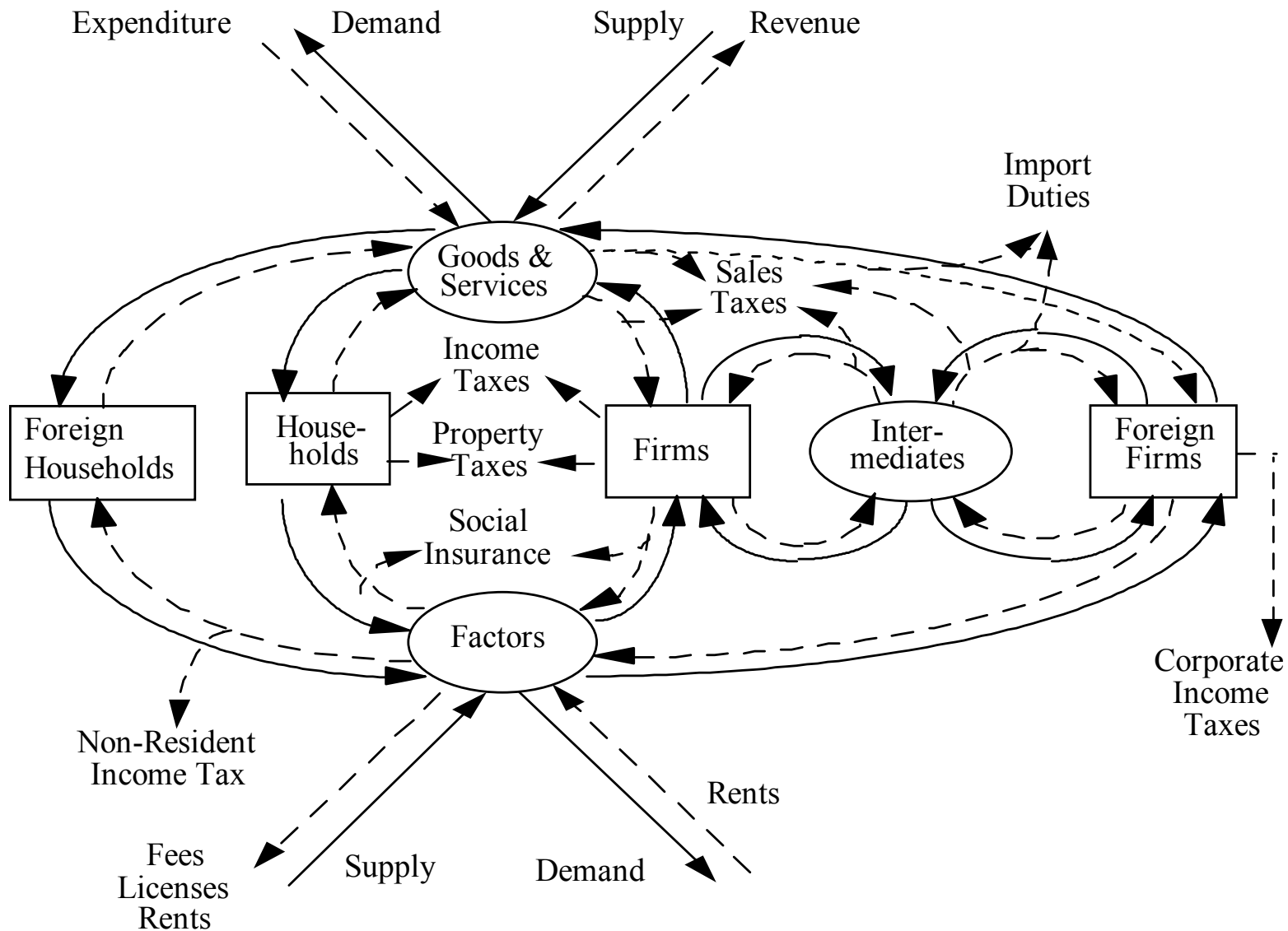


120 different
goods and
services and 120
types of firms

Two Factors:
Capital and Labor

Trade and Intermediates





Investment and Migration

- Immigration and emigration respond to economic conditions.
- Investment and disinvestment respond to the rate of return. California is a price taker in the market for capital.

Government

- Proposition 98 limits how education expenditure can be changed.
 - Nondeclining share of general fund
 - Payments for environmental services may be subject to Proposition 98. Particularly if funded from General Fund.

Income Tax

- Strongly Progressive Income Tax
 - State government budget very sensitive to changes in state personal income.
 - Model captures marginal rates (and average rates) correctly
 - Also accounts for other tax details like investment tax credit, deductibility of state taxes for fed taxes etc

Major Uses of Funds

- Model exposes the major uses of funds, like education, welfare, and infrastructure.
- Model can be used to find value of infrastructure improvements.

Consumption

- Estimated AIDS for 9 composite goods.
- Composite goods are fixed coefficient combinations of the industrial goods.
- Allows change of technology in consumption.
 - More mileage efficient cars provide same use value with less gasoline

Production

- CES in labor and capital = value added
- Fixed coefficients in intermediates, including energy.
 - Energy efficiency experiments are conducted through changing the requirements matrix.
 - Technical Innovation is imposed.

Future year linkage

- Currently from equilibrium to equilibrium
- Can be linked but would need to decide if
 - Future policies raise current personal income through the permanent income hypothesis
- How forward looking investment really is.
 - euler equation investment methods do not predict that well

Regulation and Technology

- Standard method of regulation is for ARB to find technologies (e.g. 6 speed transmission) that save green house gasses.
- Based on these technologies agency imposes effluent standard (e.g. 25% less ghg emissions).

EDRAM Uses Technologies

- The technologies identified by the agency are used in EDRAM to replace the base technologies.
- So..

EDRAM

- depends on ARB for control technologies
- firm's become more ghg efficient only to the degree specified in the “new technologies” given by the regulatory process.
- and economy reacts by...

substituting

- away from goods made more expensive
 - consumers buy less of those goods and more of other goods
 - exports of those goods go down
 - imports of those goods go up

Factor Movements

- for a regulation that is cost decreasing
 - more investment
 - more labor force participation
 - immigration
- If factors of production is immobile, then effect on State of a policy must be small.

alternative approaches

- couple with results from energy model or models. Need to know about at least:
 - electricity
 - structures
 - refineries
 - cement
- include an elasticity of substitution between energy and capital (or energy capital)

Cap and Trade

- A Cap and Trade model is equivalent to
 - an energy tax
 - with the revenue going to the quota holders

- To use a regional model and any energy model for a cap and trade:
 - Choose a set of likely prices for the permits
 - Use the energy model to find the firms chosen technologies with those prices
 - Impose the technologies on the regional model
 - Calculate the amount effluent avoided
 - Find the new prices for goods (accounting for revenue recycling, change in product prices, etc) and adjust permit prices
 - Go to step 1 and repeat till equilibrium.

Sensitivity

- Number one sensitivity: Openness to trade. Higher openness means bigger effects from policy.
- Lower sensitivity to migration and capital formation.

Summary

- EDRAM is a California model tuned to the California economy and law
- EDRAM is used as a PART of an evaluation of GHG policies